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AUTHOR Fortner, Roseanne W.
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ABSTRACT

The impact of "The Great Lake Erie," an outreach program that aimed to improve visitor knowledge and attitudes about Lake Erie, is discussed in this evaluative study. "The Great Lake Erie" was presented as a two-part program consisting of a lecture and demonstration stage presentation and a series of exhibits. The program was open to school groups during weekdays and to the general public on weekends and evenings. Visitor behavior at the exhibits was monitored, and the 17 displays were evaluated on their attention-holding ability, knowledge impact, instructional component, accommodation potential, and self-directiveness. The highest rated exhibits tended to be self-directive and highly interactive. To assess knowledge and attitude changes related to the program, a pretest-postest questionnaire was completed by visiting adults and students. Students and adults responded differently to the program. Adults showed significant knowledge gain while students did not. On attitudes, students and adults were positive on the pretest, but only students showed a positive shift on the posttest. Positive feedback was obtained from teachers who participated in the program with their classes. A diagram of the display area and exhibit design, as well as observation form, are included. (ML)

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A MULTI-PHASED EVALUATION OF THE IMPACT OF A NON-SCHOOL SCIENCE EXHIBITION

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Rosanne W. Fortner
The Ohio State University

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A MULTI-PHASED EVALUATION OF THE IMPACT OF A NON-SCHOOL SCIENCE EXHIBITION

Rosanne W. Fortner
The Ohio State University

BACKGROUND

Surveys have demonstrated that the importance of the Great Lakes, and Lake Erie in particular, is not well understood throughout Ohio [1, 2]. Important concepts include: A) The most important highway system in the world is the Great Lakes system. The Great Lakes supply the lowest cost for transportation of goods and services and consequently provide major economic impacts to the entire midwest region of the United States. B) Geological history is interesting as well as tremendously important because of the need to understand shore processes. Millions of dollars are annually spent and lost attempting to control erosion. C) The recreational opportunities provided by the lakes account for one of the major industries of the midwest and are important for tourism as well as having a positive impact on atttudes of citizens toward our natural environment. D) Over 11 million people depend on Lake Erie for drinking water on a daily basis. The future of this water resource, not only to the midwest but to other areas of this country, and the political implications of ownership and control over water resources will be significant issues in the near future. E) Within the water system is another important resource -- the life forms. Lake Erie is a well-fertilized, sometimes overfertilized, body of water with an extremely large biomass. More fish are harvested for human consumption from Lake Erie than from all the other Great Lakes combined.

Knowledge tests among Ohio students [1] found that fifth graders can answer correctly about 38% of questions on interdisciplinary aspects of Great Lakes information, and ninth graders score about 48% correct. Adults surveyed on some of the same topics [2] could answer 49% of items correctly on a knowledge test. These respondents had slightly positive attitudes about Lake Erie's importance to Ohio, and less positive attitudes about the lake's importance to the United States as a whole.

Much evidence exists that attests to the measurable importance of nonformal educational institutions as settings for affective and cognitive learning [3, 4, 5]. According to the American Association for the Advancement of Science [6], "out of school programs in science can enrich and extend the science learned in school. The in-depth, hands-on study of one aspect of science is the critical influence that has inspired many young people toward a science career." Recognizing the importance of such institutions in the development of science literacy, the National Science Foundation has recommended that increased emphasis be placed on the expansion and maintenance of high quality nonformal education programs [7].

Since 1964 the Center of Science and Industry (COSI) in Columbus, Ohio, has provided both recreational and educational experiences for 325,000 visitors annually. Part of COSI's mission in Ohio has been to bring science and technology to people in easily comprehensible forms, and through its extensive educational program offerings it provides

real world contact with timely issues of high interest. One such effort was "The Great Lake Erie," an educational program to improve visitor knowledge and attitudes about the lake.

From September 15-29, 1984, "The Great Lake Erie" program visited Findlay, Ohio, a town of about 20,000 people, located approximately half way between Columbus and Lake Erie. On weekdays during this period school groups came to the program, and on weekends and evenings the public was invited to attend. The impact of this traveling program was evaluated in several different ways. Results of the study have implications for other programs in nonformal educational settings.

RESEARCH QUESTIONS

Two types of research questions were investigated -- those relating to the evaluation methodologies and those assessing the impact of the program on visitor knowledge and attitudes. Specifically, the questions were:

1. How can the attention-holding ability of an exhibit be measured?
2. Is attention-holding ability related to the cognitive impact of an exhibit?
3. In what ways can exhibitry be rated for its programmatic value?
4. What impact does "The Great Lake Erie" program have on
    a. knowledge and attitudes of students about Lake Erie?
    b. knowledge and attitudes of adults about Lake Erie?
    c. student perception of the program experience?
    d. teacher perception of the program experience?

METHODS

Program. "The Great Lake Erie" had educational components for several groups. First, a two-day inservice workshop for teachers was conducted in the Findlay area as a means of maximizing the potential of the COSI program for school groups [8, 11]. Twenty-two teachers were provided with information and curriculum materials for teaching about Lake Erie in their classes. The materials used were specifically related to the concepts described above. They are part of the Oceanic Education Activities for Great Lakes Schools (OEAGLS), developed by the Ohio Sea Grant Education Program for students in grades 5-9. OEAGLS are a national model for curriculum development and have been extensively tested and used throughout the United States [9]. As pre-visit materials for the COSI program, it was expected that the OEAGLS would serve as advance organizers in formal classrooms for the concepts to be presented in the nonformal education experience.

"The Great Lake Erie" was presented as a two-part program. The stage presentation, a lecture/demonstration by a dynamic COSI teacher, was performed first for each group of about 150 students. Students from middle schools in the area listened and frequently responded to 45 minutes of information about geographical, historical, scientific, and social aspects of Lake Erie. Next the curtain was drawn back, revealing the exhibit area (Figure 1). As one school group advanced to the displays, another would enter and take its place in the auditorium. The entire school experience lasted about 90 minutes/group.

During public visitation hours each evening and on Sundays, the

demonstration show was presented twice for attending adults and family groups. More time was available for lingering in the display area before and after the demonstrations, since bus schedules and incoming groups did not force visitors into specific time slots as school groups had been.

Instruments. A "focal exhibit" instrument [10] was developed to assess the attention-holding ability (interest) in the exhibits. Numbers and activities of visitors at a particular exhibit were recorded by two trained adult observers for three minutes at 15 second intervals. The recording form was pilot tested and refined by a group of graduate students at COSI in Columbus. The behavior categories for the observation record included interacting with the exhibit, interacting socially, interacting both with the exhibit and socially, and passive (nonmanipulative) interaction with the exhibit (Figure 2). In order not to bias the observations by time of observation or number of people around any exhibit, a predetermined sequence of exhibit monitoring was followed (Figure 1 dashed line) for the first recording period (one group of students for 45 minutes). The sequence was reversed for a second period, and for a third it was started in the middle. This type of evaluation was used only among students, not adults.

Exhibits were classified as to whether they had a strong instructional component or were mainly entertaining or motivational; whether they were self-directing or required explanation or assistance; whether the amount of space and materials would accommodate several visitors at once, and whether their informational components were reflected in the knowledge changes measured by the pre- and posttests.

Since The Great Lake Erie was intended to be educational tool the study also utilized a pretest - posttest design to assess knowledge and attitude changes related to the program. The same questionnaire (readability Grade 6) was used for both students and adults. Its 15 questions included 2 demographics, 4 Likert scale attitude items about the value of Lake Erie, and 9 multiple choice knowledge items specific to the content of the presentation, the displays, or both. Most items were derived from an earlier test of Great Lakes information [1]. The tests were developed in three forms which differed in the knowledge items only (Appendix A). This allowed the testing of three times as much information from the groups. The three test forms had parallel subject areas for the 9 knowledge items (i.e., all contained items on water quality, lake transportation, historical quotations, etc.), but content of the individual items was different.

COSI developed a teacher questionnaire to assess general impressions of the program. It was completed upon the teacher's return to school. Teachers were also requested to have their students write letters to the presenter, and the student perceptions constituted a final form of evaluation.

Subjects. Students attending the program on one day from middle school grades in two schools answered the pre- and posttests, a total of 152 and 296 respondents, respectively. Only one class taught by a teacher from the teacher training program was among the tested group on the chosen dates. The pretest was administered to student groups (7th and 8th grades) in their classrooms before they visited the program. The posttest was answered by students on their buses as they

returned to school, or in some cases back in their classrooms. Thirty adults were randomly selected for testing at the entry and exit doors during the middle weekend of the show. One adult declined to finish the entry survey, so her data were excluded from analysis. Some adult visitors (18% of the total) responded to both pre and posttests, but none to the same test form each time.

RESULTS AND DISCUSSION

Exhibit Interest. The focal exhibit observation form proved very difficult to use in the context of the student groups at Findlay. Because of the way the program was designed, groups of 150 students were released from the demonstration program at one entrance to the display area at one moment. The initial confusion lasted several minutes, during which some exhibits nearest the entrance were surrounded and most others were ignored. As the exploration period continued, better observation conditions were established, but the planned sequence of observations was not completed within any group's stay in the exhibit area.

An attempt was made to rate exhibits for their interest level, defined as attention-holding ability, as measured by the focal exhibit instrument (Table 1). Based on 1) the number of student visitors at each exhibit, 2) the portion of the evaluation time they remained there, and 3) the amount of interaction with the exhibit, a score of 1-6 was assigned for each exhibit. Two points were possible for each criterion. The highest ranked exhibits tended to be self-directed and highly interactive (see descriptions, Appendix B). Some exhibits were attended by COSI staff or community volunteers who explained their content or directed activities. These were among those ranked next highest in interest. Linn [4] predicted that such exhibits would have the highest attractiveness, and in this case they did attract the most students. Interest measures for this study also included other criteria, however. The amount of passive behavior and purely social interactions exhibited by the students at these stations were enough to lower the interest scores below those of exhibits that actually involved participation.

Exhibit characteristics. Table 1 also indicates the ratings of exhibits on other measures: whether the exhibit contained specific instructional components (+) or was motivational only (0), whether information tested on the pre- and posttest was included, how well visitors could be accommodated in the area (space, amount of equipment for hands-on), and whether the exhibit was self-directing or not. Ratings were totaled into an exhibit score for their contribution to this program. The totals tend to be weighted toward the attention holding traits of the displays. The microcomputer simulation of a food chain, the rock salt cleavage activity and the water sampling barrels were ranked highest.

Information from these activities was also reflected in gains on specific test items of student and adult respondents. For example, item 15A: A mineral that is mined from beneath Lake Erie is..., registered great increases in awareness. Students answering the question went from 37% correct on the pretest to 67% on the posttest, while adults went from 40% correct to 87%. Test items related to relatively passive exhibits registered gains in knowledge, but not of this magnitude.

Knowledge and Attitudes. Students and adults responded

differently to the program. Adults showed significant ($P<0.01$) knowledge gain (Table 2), while students did not. For example, on Question 11A: The substance most responsible for Lake Erie's water quality problems is..., adult responses correctly identifying phosphates went from 30% on the pretest to 62% on the posttest. The majority of students, on the other hand, selected "industrial wastes" on both tests. Those students whose teacher had received inservice training did show greater knowlege gain as predicted [8, 11], but not at a significant level. It may be that the "novel setting" of this field experience interfered with the acquisition of knowledge for the students [12], while adults with more experience in varied settings were able to maximize their knowledge gain.

On attitudes, students and adults were positive on the pretest, and only students showed a significant shift on the posttest (more positive). Attitudes may have been affected by the students' levels of involvement with the exhibits, many of which were designed as motivational devices. Previous research [8] has indicated that, overall, adults are hesitant to manipulate objects while children freely touch and interact with exhibit parts. Future research will compare adult responses using the focal exhibit technique. The low public attendance at this pilot program did not allow adequate application of the method among adults.

Teacher Perceptions. On COSI's questionnaire, 90% of the teachers (N=107) rated the overall experience as "excellent" or "very good." On a scale of 1 to 5, with 5 = excellent, teachers rated the content and process evaluation items from 4.1 to 4.6. Lowest ratings were given on an item regarding the interaction of COSI staff with students. This could be attributed to the crowded conditions, with 150 students in the exhibit area at a time.

Student Perceptions. Only teachers in elementary schools were asked to have their students write letters to "Mr. COSI," the presenter, after the program, since these students did not take the pre- and posttests. Student letters tended to focus on spectacular portions of the demonstration program, such as the combustion of a hydrogen-filled balloon and pictures of wildlife killed by litter. Few references were made to the exhibits, but the most frequent comments on them were related to the need for more time in the display area and fewer students there at one time.

SUMMARY

This program served as a pilot project in bringing an educational "field setting" into proximity with potential clients. It afforded an opportunity to assess the effects of the exhibitry and demonstration programs from several perspectives, and several questions were answered. Attention-holding ability was adequately measured by the focal exhibit technique, and ideas for improvement of the method are being formulated. For those exhibits for which knowledge questions existed on pre- and posttests, attention-holding ability was related to knowledge gain.

Adults gained knowledge from the program, and students' attitudes improved. A frequent statement by the COSI lecturer for the program was "First you have to REACH them, then you can TEACH them." The combination of evaluation techniques used in this project indicates that both did occur, and the reach of COSI and the Ohio Sea Grant Education Program was extended as well.

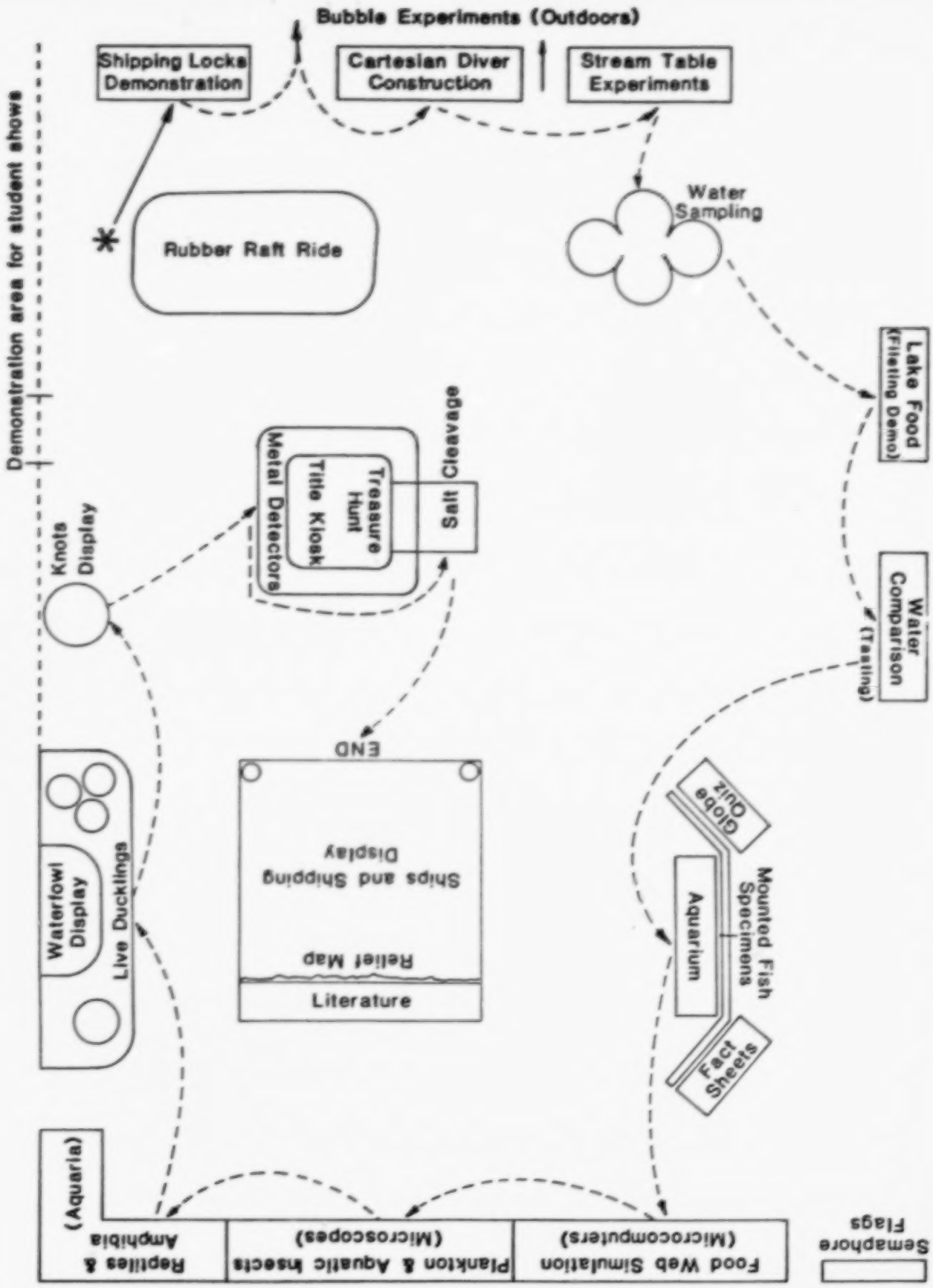

Figure 1. Focal Exhibit evaluation design for "The Great Lake Erie." Dash line indicates sequenc for observation. Sequence reversed for each evaluation period.

Table 1

Ratings of Exhibits in "The Great Lake Erie" outreach program.

Exhibit	Instructional Component	Knowledge Impact	Attention-holding Ability	Accommodation/Utility	Self-directing	Exhibit Score
Raft Ride	0	NA	3	0	•	4
Cartesian diver	•	NA	3	•	0	5
Bubble blowing	0	NA	3	0	•	4
Ship locks	•	•A-S	2	0	•	5
Stream table	•	NA	2	0	0	3
Water sampling	•	•	5	•	•	9
Water comparison	0	NA	1	•	•	3
Fish & aquarium	•	•	1	0	•	4
Microcomputers	•	•	5	•	•	9
Microscopes	•	NA	3	0	•	5
Reptiles & amphib.	•	NA	3	•	•	6
Waterfowl	•	NA	1	0	•	3
Ducklings	0	NA	6	0	0	6
Knots	0	NA	0	0	0	0
Metal detectors	0	NA	3	0	•	4
Rock salt	•	•	6	•	•	10
Ships & shipping	•	NA	2	0	0	3

• yes
0 no
NA Not applicable
• 6 = highest, 0 = none
S = students
A = adults

Figure 2

Focal exhibit observation form

Exhibit:	Time (min.)	Number of Visitors			
		Interacting w/Exhibit	Interacting Socially	Both Interactions	Passive
Time of day:	1 —				
Observer #:	—				
Notes:	2 —				
	—				
	3 —				
	—				

Table 2

Knowledge and attitude changes among visitors to "The Great Lake Erie" outreach program.

	Students			Adults		
	N	Knowledge	Attitudes *	N	Knowledge	Attitudes *
Pretest	152	50.5%	4.28	29	57.3%	4.16
Posttest	296	51.5%	4.51	30	64.7%	4.20

* 5 = most positive

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